ent disturbances are reflexly connected the movements necessary to bring the point, from which the sound comes, into the median plane of the head where hearing is most distinct and the cause of the sound may be best investigated by other senses. By a synthesis of the motor sensations thus produced, or their memory images (not necessarily conscious), with the auditory sensations, similar to the synthesis affirmed by the genetic theory in the case of sight and touch, an auditory space arises. Münsterberg's own experiments only remotely touch the question of the organ by which these variations of sound are mediated, and in our opinion he would have greatly improved his paper, as he certainly would have shortened it, by giving a very subordinate place to this whole phase of the question. The immediate point of his experiments was to determine the least observable change in the direction of a given sound. Most of the experiments were made at different points on the circumference of three circles about the head, one lying in the horizontal plane passing through the line connecting the ear-drums, one in the vertical plane passing through the same line, and one in the median plane of the head; the radius of these circles was 1 meter. The stimulus was the clicking of the head of a stem-winding watch, and was given three times at a chosen point (16 equi-distant points were tested in each circumference), then after a second's interval three times again at a slightly different point till the just observable change was determined. The general results were as follows. In the horizontal circle the point of greatest exactness was immediately in front where a change of less than 1° was recognized; the sensibility declined continuously to the point of least exactness immediately behind the head where the least change was nearly 6°. On the frontal-vertical circle the points of greatest exactness were directly opposite each ear, and directly above and below the centre points of the head. On the median circle the point of greatest exactness was 45° below the horizon (and horizontal changes also were here recognized with great exactness), thus coinciding with the point of vision when the eyes are, as commonly, somewhat depressed. Other points of maximal exactness were directly over the head and directly behind it. When one ear was stopped and tests again made in the horizontal circle the exactness was decreased not only on that side, but also on that of the open ear, showing that normally both ears co-operate in localization. When the outer ear was covered inside and out with wax, the sensibility to changes in front was decreased, but for changes in the rear was uninfluenced. The connection of the results with the theory is simplest in the case of the horizontal circle, though the author traces it in all. There the sensibility to change falls off as the muscular tension required to bring the place of sound into the median plane becomes greater; no change of place is perceived unless sufficient to produce a perceptible change in muscular tension. If the discrimination depends on the sensations of muscular contraction, it should follow Weber's Law; and, though no exact quantity can be assigned to the increasing tension, there is a striking correspondence.

Ueber Contrasterscheinungen in Folge von Einstellung; Eine vorläufige Mittheilung. Dr. F. SCHUMANN. Nachrichten v. der k. Ges. d. Wiss. und der Georg-Augusts Universität zu Göttingen. Dec. 3, 1889. No. 20. pp. 5.

In the course of a research upon memory after the general method of Ebbinghaus (now going on at Göttingen), Dr. Schumann noticed certain illusions of contrast, which he has interestingly described and brought into relation with similar effects in other fields of sensation. Nonsense syllables are cut out, fastened to a strip of paper, and rotated on a drum; they are viewed through a slit in a screen allowing just one syllable to be seen at a time. A normal rate of rotation is chosen, so that the sylla-

bles can be conveniently read for committing to memory without haste or delay. Dr. Schumann observed: (1) That when the drum was going too rapidly and he set the rate to reduce it to the normal speed, this latter then seemed too slow; (2) that if the subjects were mentally tired the normal speed seemed unusually fast, while if they were fresh it seemed slower than usual. They are both due to the carrying over of mental impressions to changed conditions; when the drum is going a little too fast it takes a greater strain of the attention to follow the syllables; a lessening of this strain seems by contrast to reduce the speed more than it really does. So when tired we interpret difficulty of keeping the attention as increase of speed of impressions. So in time experiments in passing from one normal interval to a longer the second seems unusually long, and vice versa; we seem to have a time (.7 seconds) in which impressions are conveniently attended to. When they come more rapidly we have to strain the attention to follow them; when more slowly we have to wait for them. A similar fact was observed in the motor field. If one hand moves over a normal space of 20 cm. and the other hand moves over a space of 17, 18, 19, 20, 21, 22, or 23 cm., to judge which is longer, then in moving over a space of 23 cm. the hand will frequently move rapidly the first 20 cm. and then slowly, the space moved over seeming unusually long. Here a certain motor innervation is ready and if exceeded makes the space seem unusually long. More extended observations are in progress.

Zur Lehre von der Willensthätigkeit. J. ORSCHANSKY. Archiv für Anat. u. Phys. 1889. Phys. Abth., 3–4, p. 173.

What is the nature of the difference between the two distinct kinds of exercise of the will,—the act of impulse and the act of inhibition? Is the one a setting free of energy, the other a storing of it up (Wundt)? Do they take place in different parts of the nervous system (Sietschenow)? Is it a case of simple interference of waves (Cyon)? Do these waves proceed in different directions (Goltz)? Does the struggle between the two take place in the nerve-center, the nerve or the muscle; or is the suppression of the action of one set of muscles brought about by the action of the antagonistic set (Munk)? This latter view seems plainly untenable on account of the fact that some muscles, as those in the region of the N. faciales, have no antagonists. The experiments of Orschansky were performed on the M. masseter on account of its being among the autonomous muscles, strong, of constant attachment, and admitting of easy registration of its action. They seem to show that the reaction-time of inhibition does not differ, after a brief period of practice, from that of the direct impulse. But the reaction-time of the impulse consists of four moments: (1) The passage to the sensory center, (2) the sense-perception, (3) the act of will, (4) the motor impulse; and it would be very improbable that the reaction-time of the inhibition should be wanting in any of these stages and should still be of the same duration. Moreover, very different reaction-times were obtained by varying, separately, the tension and the amplitude of the muscular excursion, and in every case the change in the inhibition-time follows closely upon the change in the impulse-time. (The author's explanation of the seemingly anomalous effects produced by these two moments does not seem to be very clear.) The effect of pathological conditions is also the same upon both. From this it seems natural to conclude that the anatomical circuit is the same for both species of exercise of the will. C. L. F.

Untersuchungen über die Empfindlichkeit des Intervallsinnes. IWAN SCHISCHMÁNOW. Philosophische Studien. Bd. V., H. 4.

Schischmánow subjects the entire problem of the sensibility to intervals of tone to a thorough and independent re-investigation. He pre-